Hydrodynamics Simulation on Deflector Program of Super Pump Station for Potable Water Supply

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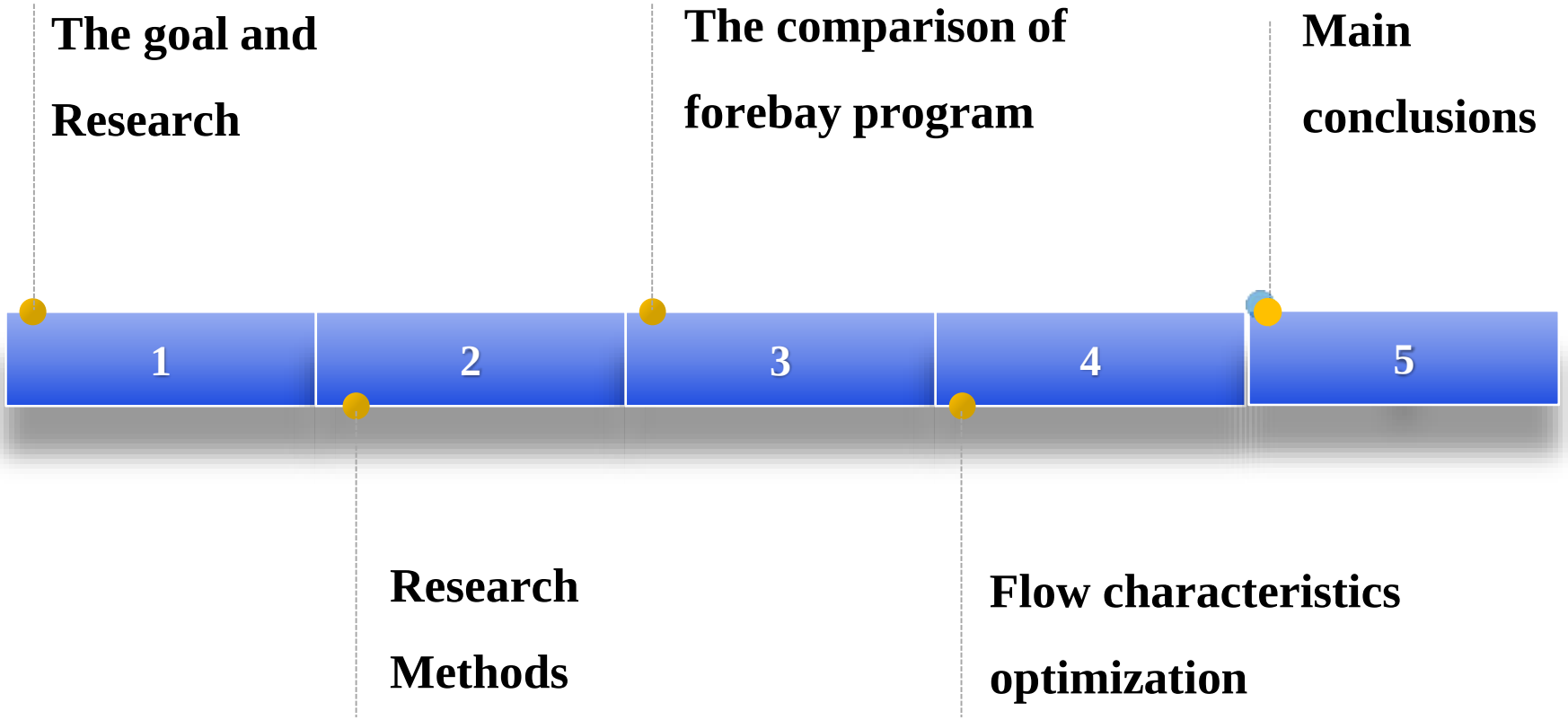
Main content



1.The goal and Research

The Yangzi River raw water projects

① Overall Scale

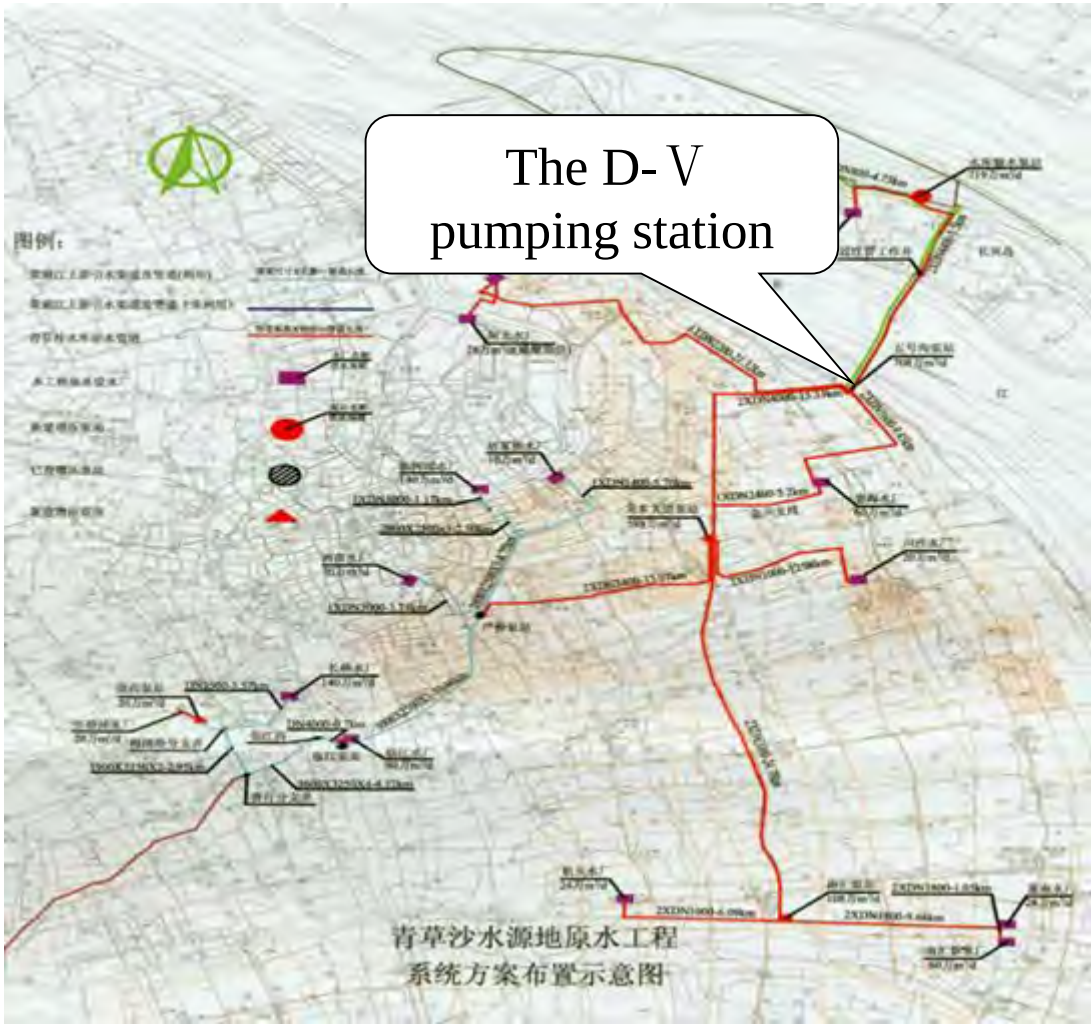
② Composition

Oversized conveyance pumping station

① general arrangement

② the basic characteristics

③ Engineering significance



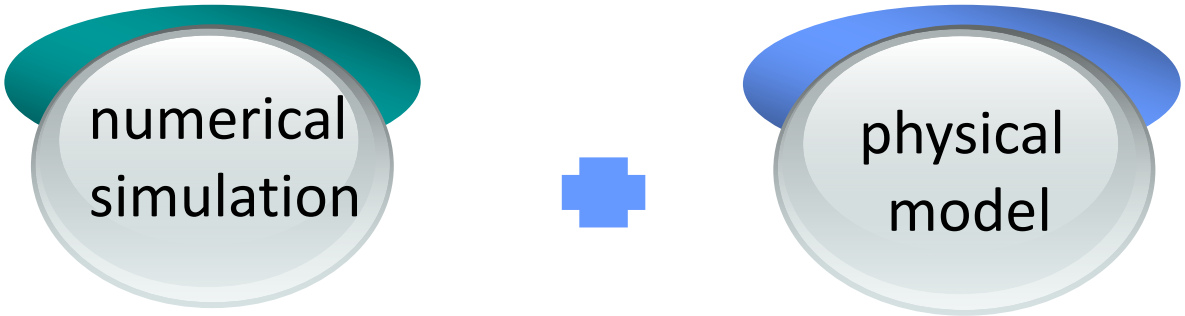
1.The goal and Research

- Design capacity of 7.08×10^6 m^3/d
- Covers area of $62{,}133m^2$
- 50% of the conventional design required area
- Large-scale water transfer，high pressure, directions and long distance

An illustration of the panoramic pumping station

1.The goal and Research

- **Water pumping station flow field numerical simulation, and optimization.**
- **The forebay rectifier engineering numerical simulation, hydraulic performance to amend the proposal.**
- **Improvement program preliminary demonstration, physical model tests.**

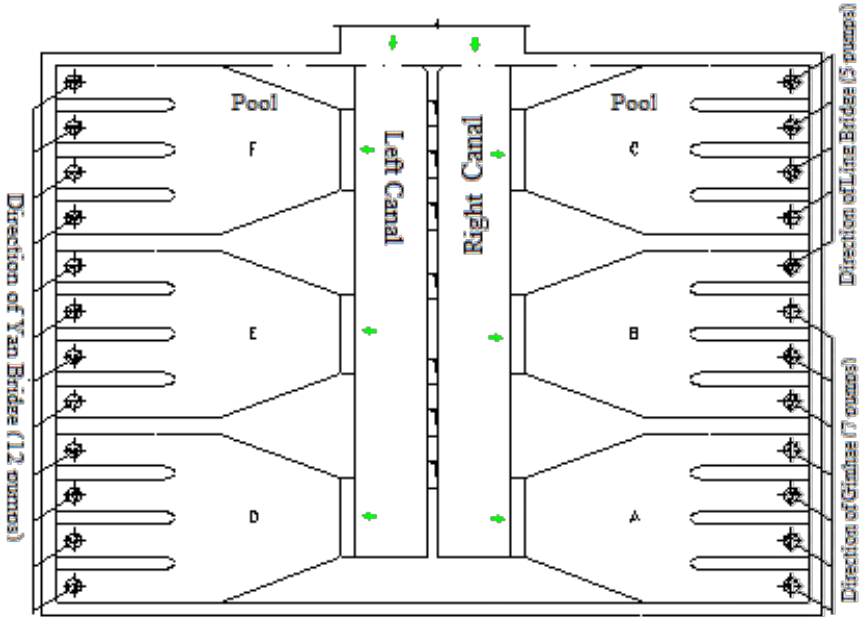


2. Research Methods

- ✓ Renault N-S equations, the Realizable kappa-epsilon model.
- ✓ Finite volume method, variables are stored.
- ✓ The source term using a second-order central difference scheme, convection, using the second-order upwind difference scheme.
- ✓ SIMPLEC algorithm, pressure and velocity coupling solution.

3. The comparison of forebay program

Program model



long strip model of option **A**

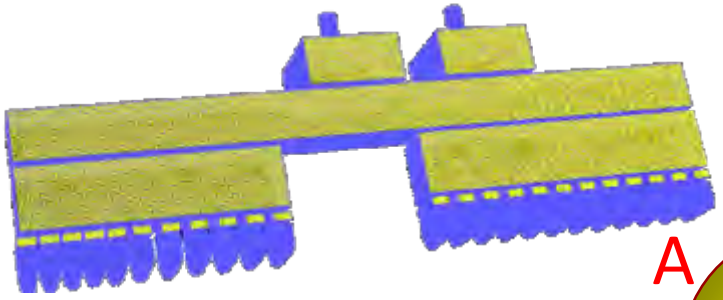
eight characters model of option **B**

symmetric model of rectangular forebay of option **C**

symmetric model of the former pool ladder of option **D**

3. The comparison of forebay program

long strip model



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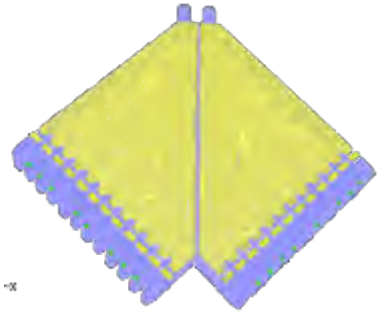


A

B

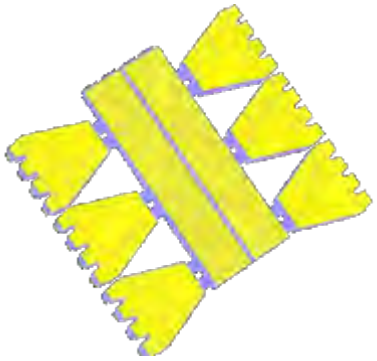
Comparison

C

D

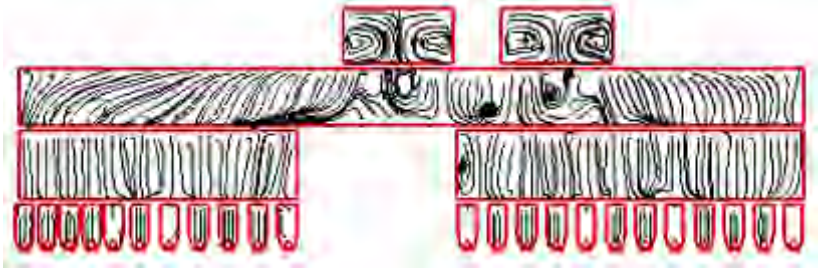
symmetric model of rectangular forebay

symmetric model of the former pool ladder



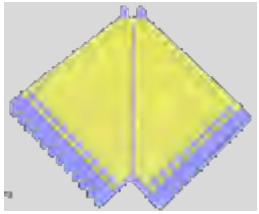
3. The comparison of forebay program

A:long strip model

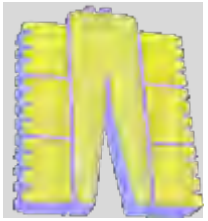


Comparison

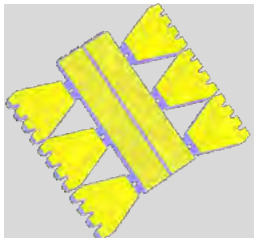
eight characters



symmetric model of rectangular forebay

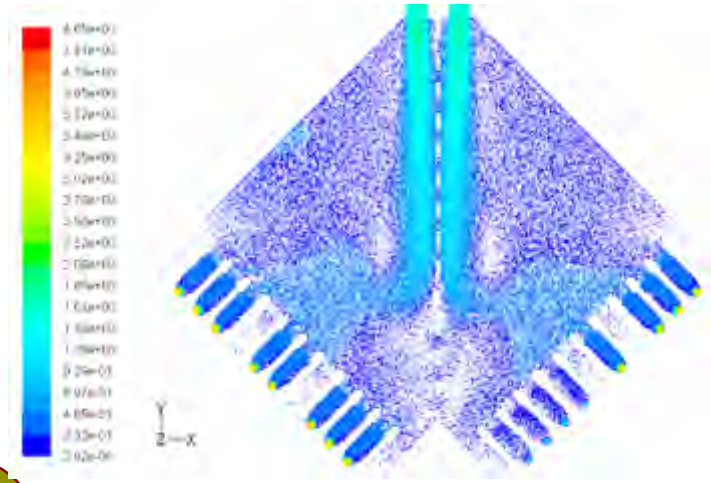


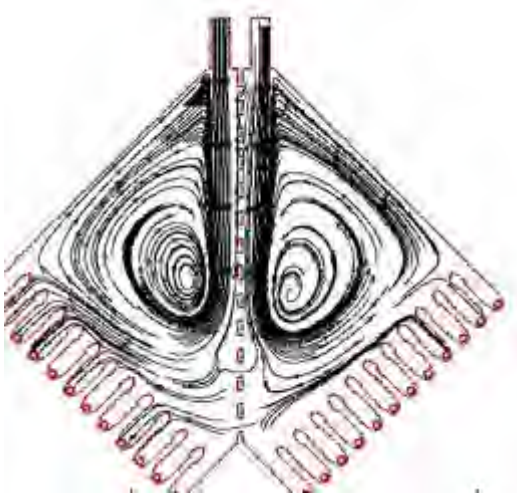
symmetric model of the former pool ladder



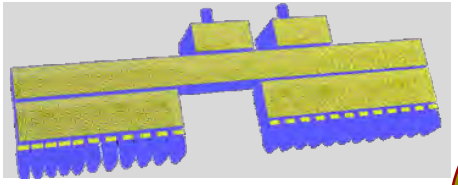
3. The comparison of forebay program

B:eight characters



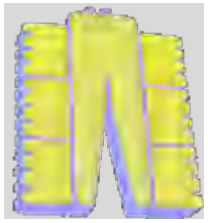


long strip model

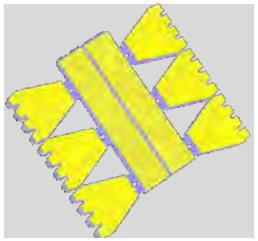


Comparison

symmetric model of rectangular forebay



symmetric model of the former pool ladder



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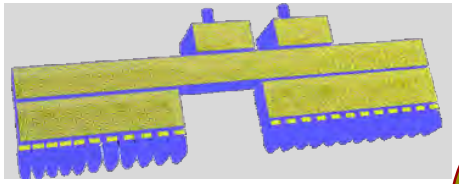

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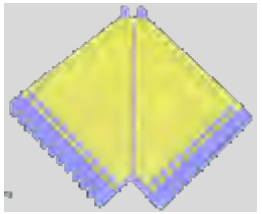
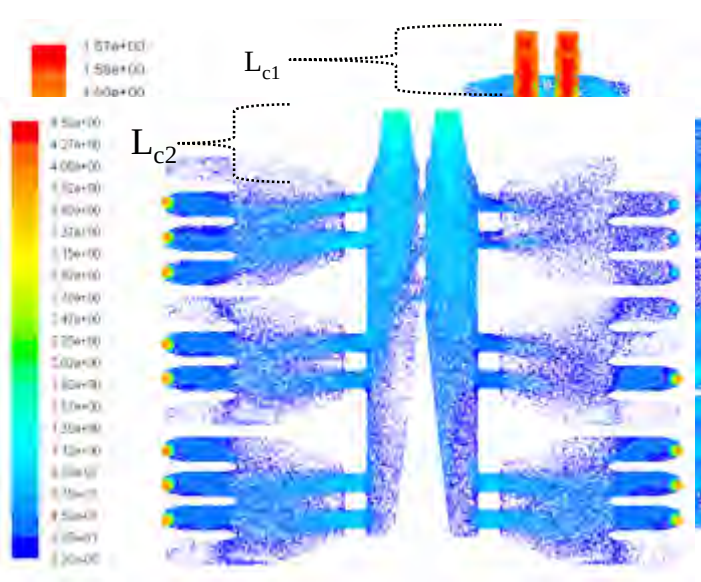
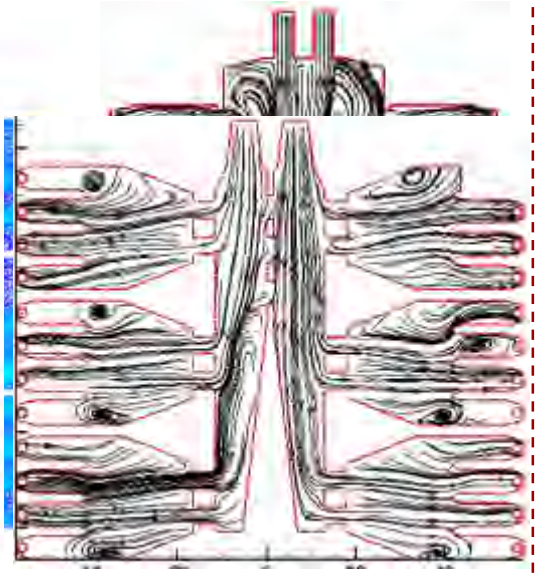


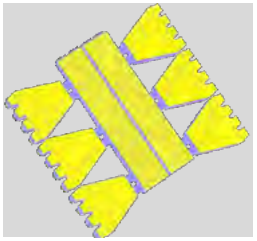
Comparison

C:symmetric model of rectangular forebay





symmetric model of the former pool ladder



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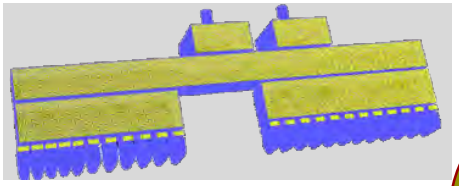
long strip model



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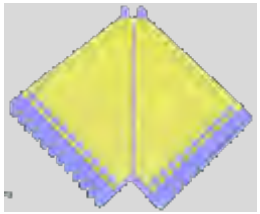
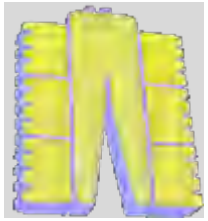
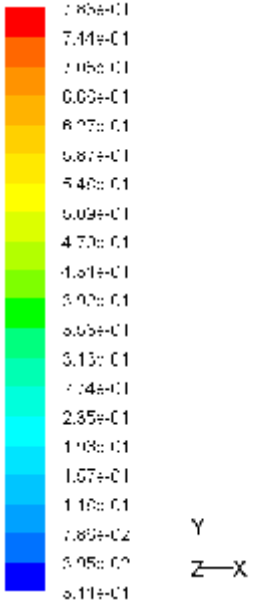


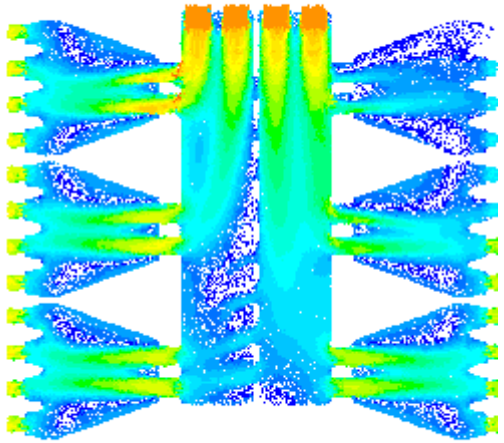
Comparison

symmetric model of rectangular forebay



D:symmetric model of the former pool ladder





4. Flow characteristics optimization

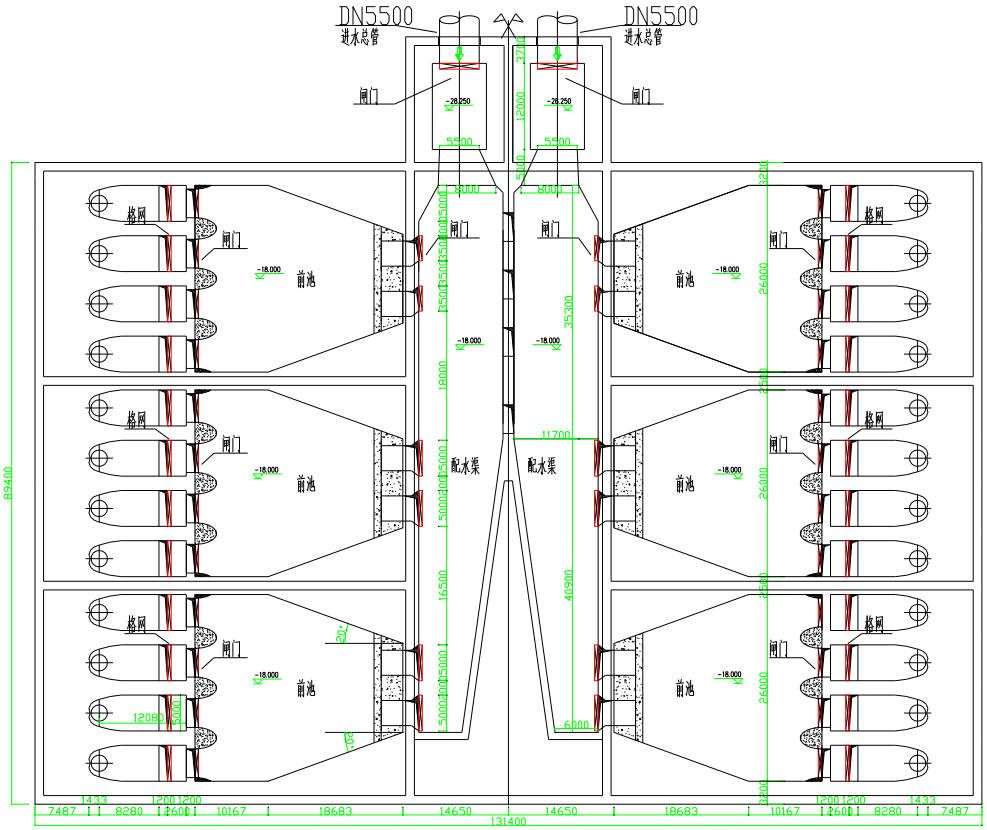
Establishment of optimization model

Rectangular pumping station:

6 cell, 24 pumps, H = 13~15m, ∆h=6.0-20.1m, Dn5500mm, v = 1.7m / s.

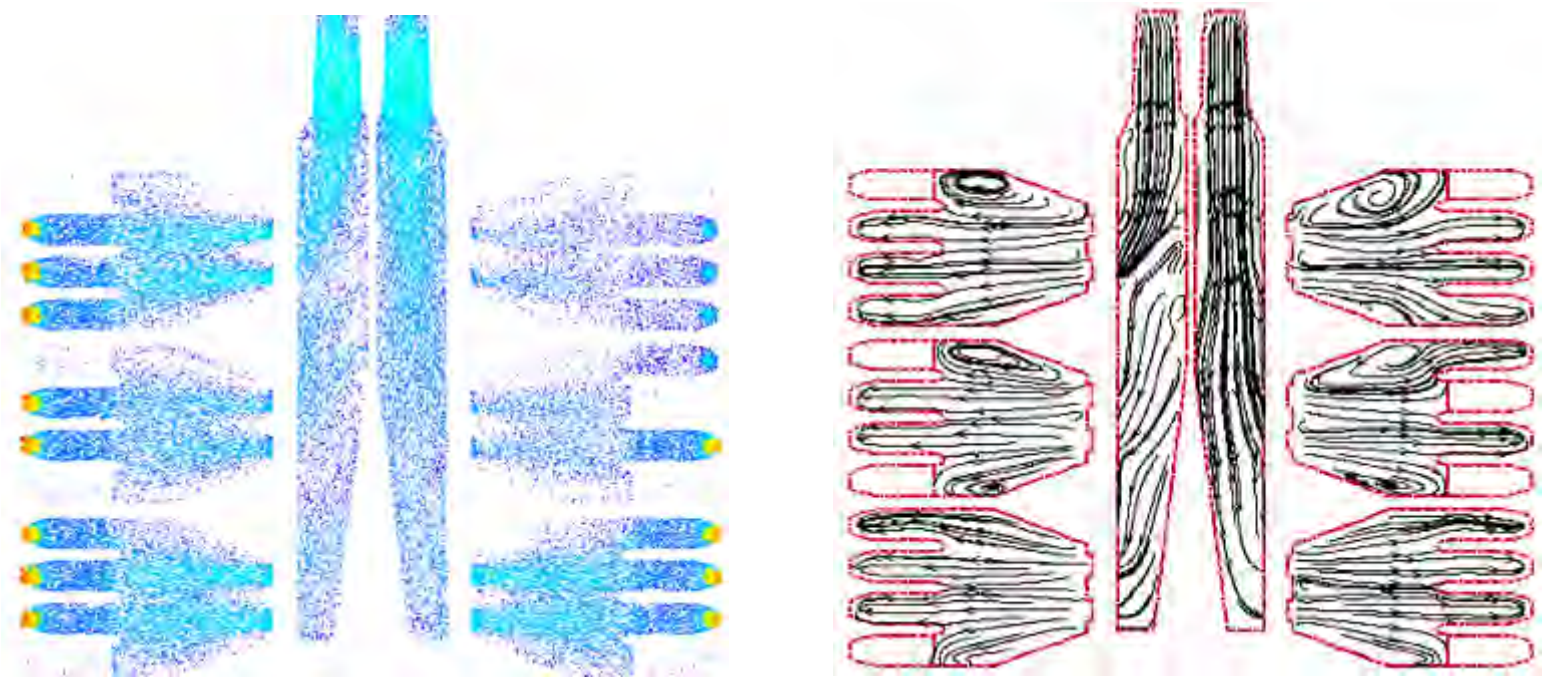
Calculate the boundary area:

Solid side wall, free surface, imported into the pool and pump suction pipe outlet section



4. Flow characteristics optimization

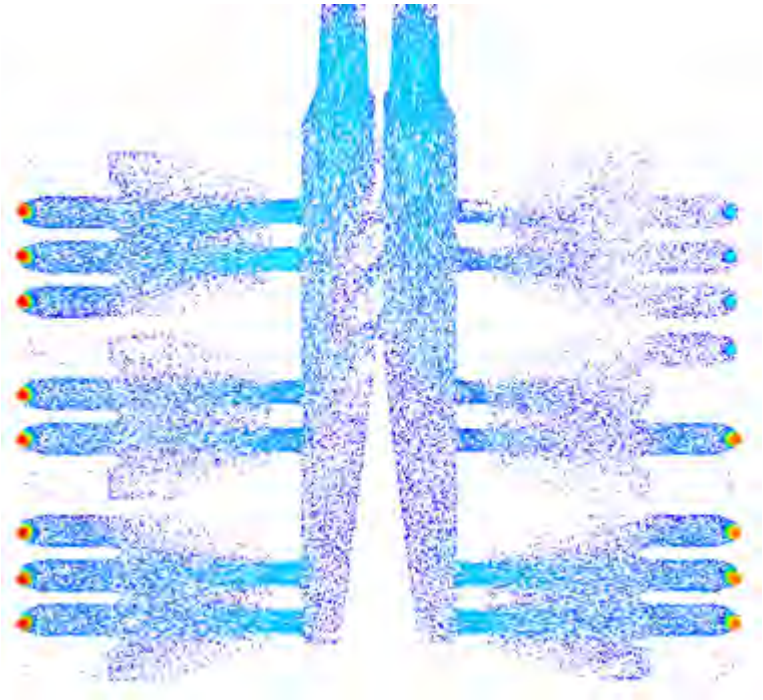
Simulation results

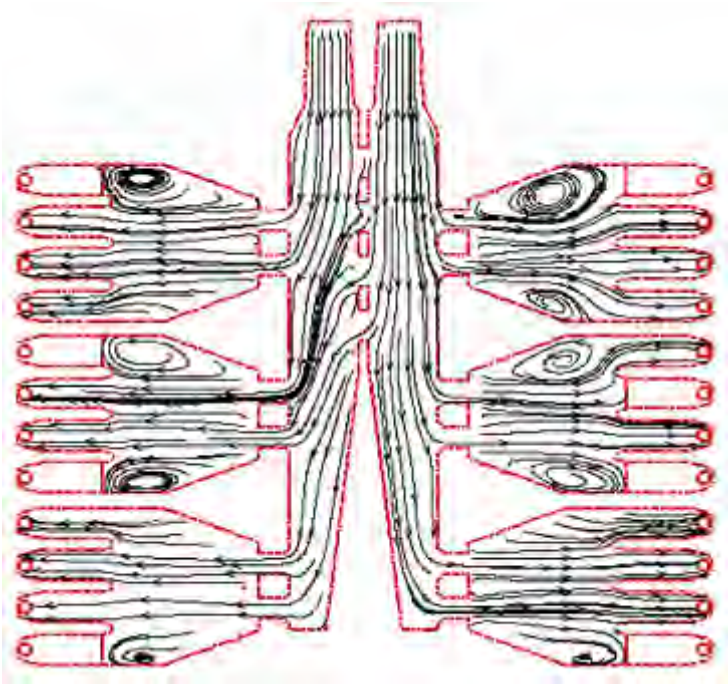


H=0.95m

4. Flow characteristics optimization

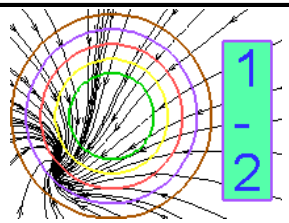
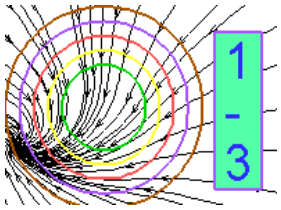
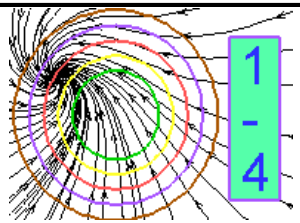
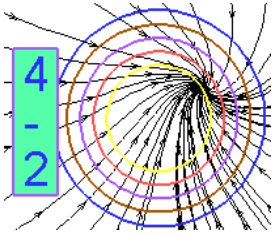
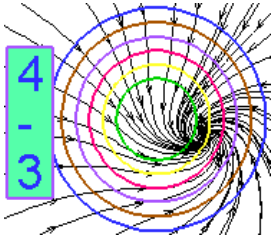
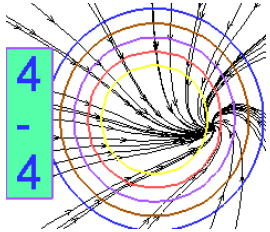
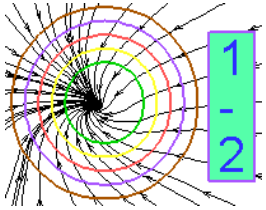
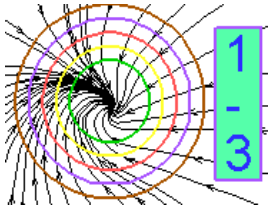
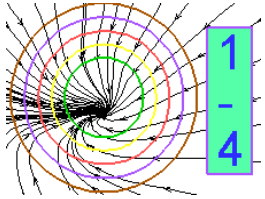
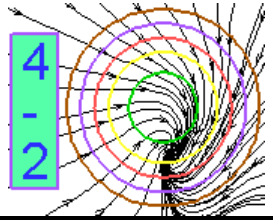
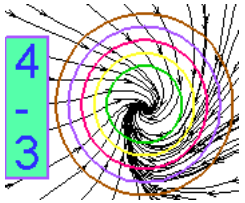
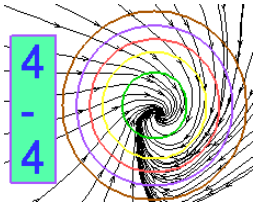
Simulation results





H=2.75m

4. Flow characteristics optimization

Diversion scheme	Bell flow lines	Drift angle	Bell flow lines	Drift angle	Bell flow lines	Drift angle
Under the bell		10		14		10
No diversion cone		8		8		8
Under the bell		3		1		3
diversion cone		7		3		1

4. Flow characteristics optimization

Simulation results

The distribution channel number statistics of pump bottom bell bias of situation

drift angle	<=8	（8~12]	>12
without diversion cone	4	13	1
with diversion cone	15	4	0

4. Flow characteristics optimization

The forebay inlet flow statistics of Pumping station distribution channel

No.	inlet flow	Flow difference	Flow summation	Flow deviation ratio (Diversion cone)	Flow deviation ratio (No Diversion cone)
1-1	-6102.39	4144.29	16349.06	25.35	23.46
1-2	-10246.67				
2-1	-4759.02	1379.68	10897.72	12.66	17.05
2-2	-6138.70				
3-1	-5014.27	869.45	10898.00	7.98	14.46
3-2	-5883.72				
4-1	-990.58	1919.54	3900.70	49.21	79.34
4-2	-2910.12				
5-1	-3536.34	-1265.35	5807.34	-21.79	17.25
5-2	-2271.00				
6-1	-6345.94	832.69	13524.57	6.16	9.77
6-2	-7178.63				

5. Main conclusions

- Increase diversion cone bell pump inlet below the bias is significantly reduced, and drift angle is generally less than 4°;

- The average flow rate of the pump unilateral deviation ratio reduced from 26.89% to 13.26%;

- The forebay figure eight guide piers program can effectively eliminate a wide range of recirculation zone and oblique flow than strengthen the diversion effect by adjusting the diversion of water distribution orifice;

- Diversion pier rectifier program distribution channel to the end of the forebay water loss drop 0.020m.

THANK YOU!

Welcome to SMEDI!

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